FAST–NEUTRON INTERACTION

WITH ELEMENTAL ZIRCONIUM,

AND THE DISPERSIVE OPTICAL MODEL

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ABSTRACT

Differential neutron elastic– and inelastic–scattering cross sections of elemental zirconium are measured from $\approx$ 1.5 to 10 MeV. Below 3 MeV the measurements are made at incident-neutron energy intervals of $\approx$ 100 keV, from 3 to 4 MeV at intervals of $\approx$ 200 keV, and at intervals of $\approx$ 500 keV at higher energies. The angular range of the measurements is $\approx$ 18° to 160°, with up to more than 100 differential values per distribution. This comprehensive data base, augmented with a 24–MeV elastic–scattering distribution from the literature, is used to develop two phenomenological optical–statistical models which both describe the data very well. First, the parameters of the conventional spherical optical model (SOM) are deduced. Secondly, the model in which the change in the real potential brought about by the dispersion relationship (DOM) is examined. The SOM parameters are consistent with systematics previously reported from this laboratory, and the volume–integral–per-nucleon of the real potential strength, J_v, and the radius, r_v, are energy dependent. When the DOM is used, a substantial part of the energy dependence of J_v ($\approx$ 30%) disappears. However, the change in the energy dependence of r_v is small, so that a significant energy dependence remains when the DOM is used. Both models are extrapolated to the bound-state regime where they have modest success in predicting the binding energies of the single–particle and single–hole states in ^{90}Zr.